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Articles

Does not include major discussion.

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Comments on Howard Gruber's "Aspects of Scientific Discovery: Aesthetics and Cognition"[1]

Bryce Douglas: *Your reference to R. B. Woodward at Harvard, the organic chemist, interests me. As the aesthetic person, he was supreme. The whole music of his science was enthralling. The only problem I had with it was that, after the music ceased, I didn't know what had been going on at all. In other words, he took me into the aesthetic side of it, but he never left me with anything more skillful than I had before. So I think in that sense he was teaching as a mentor. Nonetheless, he was a remarkable teacher in other ways.*

Howard Gruber: *He did win some people to thinking that they could understand him. He had many collaborators who worked with him and worked for him, didn't he? For those of you who haven't had a chance to read it, I do have some long quotations about Woodward in this paper. He is a prime example of somebody who made the aesthetic mood evident in his work.*

Douglas: *Now can we recapture thoughts from any part of the day that you wish.*

Frederic Holmes: *One of the descriptions you might have included for the experience on page 8, but didn't, was "being thrilled." And in order to draw what you said perhaps a little closer to what the scientists have said this morning, I would like to draw attention to a passage in Sir Andrew Huxley's Florey Lecture, where he talked about putting the pipette at the Z-bands and between them. And he said, "the moment when I first saw this response was the most thrilling of my scientific life." So I'd like to ask you if you regard that as an aesthetic experience of the kind that Howard Gruber is talking about, and if so can you describe it in more detail?*

Sir Andrew Huxley: *I regard it as a rather low level of aesthetics, certainly nothing very high powered or highbrow. It was largely because I was hoping it would happen and, well, sure enough it did. I think anyone finds it quite fun to see this happening on a film of the muscle fiber, where the striations go tweak, tweak, each time. And I had been working for a long time building the equipment to do this and it worked first time, so I would say "thrilled" is a better word than "aesthetic experience."*

Holmes: *You seem to be downplaying it a little bit now and it seems to me "thrill" is a very strong feeling that you probably chose with reason, so it must have been a powerful feeling.*

Huxley: *Well it was, but more deriving from hope and expectation, and from having it realized before one's eyes, than anything one would really call beauty of the event. As I say, I think other people find it quite fun to watch the film, but the thrill really came from a combination of hope and expectation.*

Michael Sela: *Referring to the lecture of Professor Nickles, and the mention of "romantic" and "enlightenment" as the two extreme stereotypes; actually, you might have also*

[1]The full text can be found in *Creativity: The Reality Club* (Touchstone Books, 1993, pp. 48–74).

chimeric types of stereotypes. I think that very often what happens is that you have one moment, which I prefer to call "intuition." Maybe this is the strategic level. Then, at the tactical level, everything gets in line logically. This is one possibility, whereas the other one is that you may actually reach a discovery in the most logical and deductive way, but then you have the feeling of beauty as a result of this achievement. In this connection, it is pertinent to quote von Helmholtz, and I happen to have here the English translation of his statement in the Academic Address he gave in Heidelberg on the 22nd November, 1862, which describes the beauty of science in such a wonderful way:

> *Whoever, in the pursuit of science, seeks after immediate practical utility, may generally rest assured that he will seek in vain. All that science can achieve is a perfect knowledge and a perfect understanding of the action of natural and moral forces. Each individual student must be content to find his reward in rejoicing over new discoveries, as over new victories of mind over reluctant matter, or in enjoying the aesthetic beauty of a well-ordered field of knowledge, where the connection of every detail is clear to the mind, and where all denotes the presence of ruling intellect; he must rest satisfied with the consciousness that he too has contributed something to the increasing fund of knowledge on which the dominion of man over all the forces hostile to intelligence reposes. In conclusion, let each of us think of himself, not as a man seeking to gratify his own thirst for knowledge, or to promote his own private advantage, or to shine by his own abilities, but rather as a fellow-laborer in one great common work bearing upon the highest interests of humanity.*

Joshua Lederberg: *I want to add a noun to describe the thrill on occasions when an experiment came out, and it's "dread." Maybe I'm reflecting the schizophrenia that I keep talking about, but when you reach that level of consummation, the fear is that it may have been a* mistake! *Maybe there was an artifact; maybe there was something wrong in it. And having been carried to that pitch and gotten to that kind of commitment, there really is the dread, "My God, nature may be playing a trick on me." But I've really had it at this point, I can't let go at this stage. And your hopes may be dashed. It's followed by a very intense period of, I wouldn't say exactly doubt, but questioning: "What could possibly have gone wrong with it?" And so forth. I've had that experience several times.*

Gruber: *Are the dread and joy inseparable? Does there have to be the possibility of failure in order—Shelley said it better—in order to have the highest joy?*

Lederberg: *Well, if it's important to arouse that thrill, then there's also the anxiety about disappointment. It's something that you internalize; and it may just fall apart, and that's the dread.*

Sir Roger Bannister: *I should like to ask a question of Dr. Gardner. Sir James mentioned the neurophysiology of creativity, which obviously is, of course, far beyond us, but the question of the effect of any focal brain lesions I think is of interest. There was a philosopher who was creative, who then suffered brain damage due to a brain tumor, and whose changes of thinking were followed. Dr. Gardner mentioned artistic creativity in fields other than science, and I wondered whether there had been cases in which, through brain scanning techniques, we knew if changes in certain focal sites had produced changes in creativity? Is there a predominance of nondominant hemisphere lesions, for example? I think it would be interesting to know whether there are any clues from this kind of evidence.*

Gardner: *I think the most interesting result from neuro-psychological research is that you can discern stylistic changes occurring in visual artists who suffer focal brain disease, and sometimes those stylistic changes strike the field as being very interesting.*

There are two German artists who had a fairly realistic style, both of whom suffered nondominant hemisphere pathology, and their paintings became much rawer, more primitive, more direct, more elemental, if you will. There is, in fact, art criticism written thereafter that talks about their style actually having improved as a result of that pathology. Now, of course, this shift to a more brutal style is contaminated in the sense that you might talk about there being a shift in the 20th century in general in that direction. But I've argued in my writing that, if you consistently get a stylistic shift on the basis of one kind of brain pathology, but not in terms of another kind of brain pathology of roughly the same size, and even at an analogous site, then it's proper to attribute that stylistic change to that particular variety of brain damage. And I think you can make that case in the present instance. These two artists were Lovis Corinth, who was quite well-known in Germany earlier in this century, and then Anton Räderscheidt in the middle of this century. They were studied by Dr. Richard Jung. You certainly get disintegration of style in music, literature and the visual arts as a result of brain disease, but if it's simply disintegration, or less good, then it's of less interest to our particular question.

Currently now in America there is one very interesting artistic deterioration going on, but nobody knows the details because the artwork is under lock and key. And that's Willem de Kooning, who is considered to be the major living American abstract expressionist. It is said he has Alzheimer's disease, yet at the same time, he gets up every morning and paints. Which to my mind already causes some question about whether he has Alzheimer's disease. But nobody's seen the paintings, and this offers a great opportunity for speculation. There definitely is a literature along the lines that you describe, but I would say that, with the exception of the purported specific shift to a more primitive depicting style in visual arts based on nondominant hemisphere pathology, you either have a case where the artistry continues uncontaminated, and that happens a fair amount, or you just have a general and unilluminating deterioration.

Salome Waelsch: *If you are in search of an aesthetically pleasing biology text book, there is a new edition of Molecular Biology of the Cell, by Bruce Alberts, that is really very beautiful.*

Sir Christopher Booth: *Just two points. On the question of excitement, I spent all my life as a practicing clinician trying to find things out, and I can only say that, for any practicing clinician to get a diagnosis right, and then correctly treat the patient, is exceptionally exciting. But there's only one thing more exciting, and that is to have done a piece of research that enables you to state a truth, which then enables you to treat a patient whom nobody else could, because of what you've done.*

The second point I wanted to raise was about Darwin. I wonder to what extent any scientists have been inhibited by the views of their teachers in terms of promulgating new ideas, and ideas that offend their teaching. Darwin was obviously in that position. His geology teacher, the Trinity man at Cambridge, was the Woodwardian professor, Adam Sedgwick, the so-called talking giant. When Darwin got back to Madeira from the Beagle voyage, there was a letter from Sedgwick saying Darwin would be known as one of the first of the scientific men. Darwin says he was so excited by this letter from his old teacher that he rushed around the island with his hammer, chipping off bits of rock, he was so enthusiastic. And yet when he sent his first edition of the "Origin of species" to Sedgwick, Sedgwick replied sadly that he received the book with more pain than pleasure.

Gruber: *Darwin had evolved and Sedgwick hadn't.*

Baruch Blumberg: *There are many comments I would like to make, but I will restrict myself. Mention was made of the aesthetics of the absurd. As one grows older, it becomes more and more apparent that there is much humor in life and in nature. It has been said, perhaps hyperbolically, that life is analogous to a moderately good Monty Python movie.*

If nature does have some humorous or absurd quality, then perhaps experiments should be designed with that model in mind. For example, we made an observation that the manner in which parents respond to infection with hepatitis B virus may have an effect on sex determination, that is whether their offspring are boys or girls. On the face of it, it seems absurd that a virus can have such a biological effect, and it was in part because of this "absurd" model that we undertook the project.

Bedbugs, for some reason, are considered a laughable insect, but I can assure you that it does not seem very funny to those who have to live with them. We became very interested in HBV insect transmission and, for a long time, had one of the few colonies of tropical bedbugs in America.

Huxley: *If you don't mind a change of subject, I was going to reply to Professor Nickles' two questions. One was the extent to which one's research was an adaptation of something previous. As regards my muscle work, part of it has been microscopy, which is, after all, a very long tradition. And at Cambridge, histology is included in physiology, not in anatomy, so I was brought up on microscopy as an undergraduate, in addition to having had microscopy as a hobby when I was a boy. And I already mentioned that the servo-control of length in a muscle fiber was closely analogous to the servo-control of membrane potential in a nerve fiber, which originated partly with Hodgkin, and partly with Casey Cole. I got to know of it through working with Hodgkin. Again, I studied the mechanical properties of active muscle by means of steps, as opposed to superposed oscillations. That again was what Hodgkin and I did, with success, on the nerve membrane. The oscillation approach by Cole had really concealed the interesting nonlinearities in the same way that Pringle's approach, using oscillations on muscle, had concealed the interesting nonlinearities there.*

Your second question was: "Are there examples of major scientific advance depending on a very peripheral observation?" Well, the big case of a successful and important revolution in muscle was in 1930, when the lactic acid theory was demolished by Lundsgaard's observation that a muscle poisoned with iodoacetate would contract perfectly well, but produced no lactic acid. In that series of experiments, Lundsgaard was not investigating muscle as such, he was investigating the "specific dynamic action" of proteins, that is to say, the increase of basal metabolism with the proportion of protein in your diet. He was investigating the effects of individual amino acids on basal metabolism, and as well as amino acids, he tried a number of other derivatives of organic acids, including iodoacetic acid. And so the observation on muscle was a pure by-product: he noticed that when he applied this substance on a bit of muscle tissue, no lactic acid was produced when the muscle was active.

Schaffner: *A question to Howard Gruber. I wonder if we shouldn't think about two different ways to approach the concept of aesthetic in science. One way would be to look at certain kinds of criteria, such as simplicity judgments, or simplicity types of judgments. That approach scientists use when they decide whether or not a hypothesis is worth testing, for example, or worth developing.*

What I have in mind is the comment in Jim Watson's book when he talks about Linus Pauling's strategy of trying to work with simple molecules first. That I think might be somewhat objective, and a useful kind of constraint on our deliberative powers. It's judgmental simplicity. It's not well defined, but Einstein said in his "Autobiographical Notes" that the scientists often agree about it. The second sense of the term aesthetic might be what you were primarily talking about: It's the thrill or the joy, the appreciation of the beautiful as we see a finished product or a partially finished product. I think maybe the first will cause the second, or perhaps just the solution of a problem will cause the second. But it might be useful to distinguish those two senses.

Gruber: *I agree with that. I'd just like to add one thing that occurred to me as you were talking. There might conceivably be an important historical change going on, because after all, we are capable of dealing with more and more complex systems now, and science is imperialist in that way. Maybe as that happens, the things that we have available to appreciate that will determine what it is we like, what it is that generates aesthetic feeling in us—these things may evolve simply because there must be some element of freshness and novelty about aesthetic experience. The other day I was imagining a world in which, say, Beethoven's Ninth Symphony constituted the noise of that world, because it was played constantly. Well it would lose its quality as music at some point. But that wouldn't mean it wasn't music. It would have to be something that transcended that. Maybe we're on our way to new forms of aesthetics. I read Gleick's book on chaos recently and wondered about that.*